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SOME ANTHROPO-GEOGRAPHIC EFFECTS OF GLACIAL EROSION IN THE ALPS

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THE theory that alpine glaciers are eroding agents has within recent years made rapid progress. Its acceptance, while not universal, is at least general. The extent of the effects which may be ascribed to this agency varies from a mere alteration of valley forms, mainly by lateral erosion, to the deepening of valleys by thousands of feet. The first-named effect, often called *over-steepening,* is the minimum acknowledged by all who may be called glacial erosionists. The second effect, called *over-deepening,* is accepted by most of them in varying degree. Either process changes the typical stream gorge, commonly called V-shaped, into a more open, smoother-bottomed and steeper-sided valley commonly described as U-shaped.

It is generally agreed that glaciers make their own cirques, cut down their floors, give them their often nearly vertical walls and cause the recession of these walls and widening of the cirques by a process appropriately called plucking. A necessary corollary to this is the narrowing of the ridges which separate neighboring cirques. Plucking may continue until little is left of these ridges but a narrow rampart whose crest is a series of crags or pinnacles. A continuance of the process may remove even these and cause the merging of adjacent cirques.

The purpose of this note is not to discuss glacial erosion or to show its importance in the Alps, both of which we may be allowed to assume, but to point out some of its effects on habitation.

The first of these effects is that of the characteristic scenery. It is true that scenery itself belongs primarily to physical and not to anthropo-

geography, but Switzerland and its immediate neighbors are among the places whose scenery is a leading asset in a commercial way, and for this, if for no more subtle reason, a most important element in anthropogeography. Whether glacial erosion be a fact or not, the features commonly ascribed to it are those which are most striking and characteristic in the Alps mountains. They are in fact those which make up a distinctly alpine style of topography as distinguished from that of other high mountains. Switzerland would probably be a beautiful place even without glacial erosion, but it would not be Switzerland. It might be visited by tourists and cultured people, but the flavor of the place, however delightful, would be something quite different from that now recognized. Take away the cirques and their over-steepened walls and there would be no Matterhorn. Remove the pinnacled partitions between neighboring cirques and there would be no Schreckenhorn. The whole list of familiar "horns" would disappear with all their peculiarly alpine settings and in their places would be the still beautiful but more commonplace types of erosional topography.

The first effect of over-deepening by glaciers is seen in the many and beautiful lakes, for valleys were subject to very unequal deepening in different parts, thus making a succession of basins and cross-ridges. These lakes were formerly explained in other ways. Their influence on habitation may be illustrated by comparing the shores of Lake Geneva with the valley of the Rhone farther east, or those of Lake Como or Maggiore with other parts of the valleys which they occupy.

Even where there are no lakes there are sometimes beautiful alluvial basins, filled with sediment instead of water, and separated from one another by rock ridges where the glacier cut less deep. Through these rocky ridges the stream may rush in narrow gorges while loitering and broadly meandering through the intervening basins. Adjacent basins of this kind may support strongly individualized communities.

Next to the lakes the most striking features due to over-deepening are probably found in its effects on tributary valleys. Instead of decreasing in grade from source to mouth, as streams normally do, these join the master stream with a final plunge, not always vertical but often by a series of cascades, generally through a height of hundreds of feet; sometimes for several thousand feet. These are called hanging valleys. Among tributaries this condition is the rule and not the exception. In a single large valley may often be found thousands of vertical falls and rushing cascades, any one of which would make an American city famous. Some-

times the valley is so deepened and widened below that its sides overhang and the stream falls through the air for many hundreds of feet as at Lauterbrunnen. It will scarcely be questioned that the beauty of one Lauterbrunnen is at least as important in anthropo-geography as the power of a dozen such falls devoted to manufacturing.

But there are many hanging valleys which are not known among visitors for their beauty, but are well known among residents for the sudden wildness and destructiveness of their floods. The local name given to these is *wildbach* (literally "wild brook"), which has no English equivalent except the feeble expression "mountain torrent." The destructiveness of the *wildbach* comes largely from its final plunge into the over-deepened valley of the master stream. Its injurious work is effected partly by the power of its rushing waters and partly by the burial of the lower valley with gravel and coarse rubble. We know something in the Southern Appalachians of this double effect of mountain floods, but to make the case parallel we must conceive the Southern Appalachians as lifted from 5,000 to 10,000 feet, their gorges greatly deepened by stream erosion, then further deepened and broadened below by ice, and the tributaries made vastly steeper in their lower courses. Then the forest should in large part be removed to allow prompt run-off.

The inhabitants of many localities live in perennial fear of the *wildbach,* so that fine alluvial fans in the master valleys may remain unoccupied by dwellings and uncultivated. In other cases they have been occupied only in more recent years, owing to increase of population and advance in engineering science by which the torrents are in part controlled.

It is only a step from this constant dread to the myths of folklore which assign the dreaded power to personal, half-human agencies. The sudden and half unaccountable advent of torrents of water doubtless lies at the base of such myths as are described in the classical legend of Undine. The essence of this is the exercise of a half malignant power by a race of water-sprites, human in all superficial respects, but without souls.

Perhaps nothing else is quite so characteristic of life in the Alps as the use of high pasture lands. So characteristic are these of the Alps that they have given their name to the mountain range, for the word "alp" was originally a common noun used to designate such pastures. The origin of these is a part of the glacial history of the region. Some of the highest are believed to be remnants of a pre-glacial mountain surface. This old surface was one of rounded or subdued mountain forms,

perhaps resembling the Schwartzwald or Southern Appalachians and produced by water erosion when the surface was much nearer to the sea level than at present. As the result of uplift the revived streams destroyed much if not most of this surface. Then glaciers widened the valley bottoms and expanded their heads as cirques until little of the old rounded mountain surface remained. These last remnants are believed to be represented by some of the highest rounded pastures of the present time.

The greater part of the high pastures hang, terrace-like, on the mountain sides. Such terraces are neither flat nor continuous, but are rather interruptions of the general valley slopes whose steepness between terraces is often precipitous. These terraces are believed to be remnants of former valley bottoms. If so, these older valleys must have been wider than those now existing and their bottoms higher, sometimes by several thousand feet. They were, then, quite as unlike valleys made by mountain streams as are those of to-day. They seem to have been the U-shaped valleys of former glacial epochs, whose floors were but partly destroyed by subsequent stream erosion and by the glacial erosion of later epochs. Often two or three such terraces may be seen rising successively above the present valley floor. Many have been tentatively correlated and assigned to particular glacial epochs.

The manner of life induced by these high pastures and their step-like arrangement is almost unique. The pastures at different altitudes become ready for use at different times, the lower first, and successively higher ones as the season advances. The life of the shepherd is therefore migratory but according to a definite plan. The direction of his migrations is vertical. The number and location of his halts are fixed by a process of adjustment which has extended through generations. Each halt becomes his home for some weeks or months. Buildings are always in waiting. In this way whole villages of substantial stone houses are left unoccupied during the greater part of the year, but become centers of life when their surrounding pastures are ready for grazing and the meadows for cutting.

The importance of the third dimension in alpine lands is not limited to pastures. The elevation of vineyards often differs from that of grain fields on the same slope and these again differ in elevation from pasture lands; all differing in their seasons of activity as they do in altitude. In some valleys a single family may have as many as four homes, each occupied for some part of the year by a part or all of the family.

THE INTERPRETATION AND USES OF MAPS

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IN taking up the presentation of topographic maps, I shall simply outline my own method of presenting the subject to my classes. Perhaps some teacher may receive a suggestion for overcoming a difficulty he has encountered.

A child's map study in the grades is very superficial, and by the time he reaches the subject of Physiography many of the facts he has learned in the grades have slipped from him. Therefore, it is well to begin with foundation principles in introducing him to topographic maps. At first show him only maps of two dimensions and let him *make* maps of this kind. It is rather interesting to notice the lack of training in observation in the average student if requested to make from memory a sketch map of his walk home. He has the most distorted idea of the angles of the street, and can hardly put in all the houses in a single block. Often he cannot make a ground plan of his own home. The student is usually mortified by such ignorance and begins to cultivate his powers of observation. Next, let the class make a more careful map of some portion of the school grounds by means of the compass and tape line. This is described in full — including the drawing-in of the contour lines — by Mr. Philip Emerson in the JOURNAL OF GEOGRAPHY for December, 1906. In this way the student sees the difficulties that the geographer must overcome in a small space, and is prepared to note these and other difficulties, such as the curvature of the earth, which are encountered in mapping larger areas. He will be interested in seeing how these difficulties are overcome by the Mercator, Stenographic and Conical-projection type of maps. He should be shown the advantages and disadvantages of each kind.

The student, by this time, will see the need of a third dimension to indicate relief. Explain to him hachure, relief, and contour maps. He will grasp the first two from a few words of explanation, provided an example of each is at hand. He must be shown their faults before he will give his best efforts to learning "to spell"—as Davis puts it—the more accurate form of contour mapping. The first step in this spelling process is well described on Page 11 in Trafton's *Manual*. Making a relief map in clay and then mapping it in contours, putting in the contour lines in his map of the school grounds, taking a map of two dimensions and locating fifty or a hundred points on it, with the altitude at each point, and drawing the contours through these as described in Page 21 in Davis' *Teacher's*

Guide to his *Elementary Physical Geography* are all helpful exercises. Much also is learned from constructing given things with contours; for example, constructing a hill 100 feet high with a ravine of varying depths. In explaining these show how the valleys make the lower lines run up higher, therefore the contours must turn up the valley. Make these drawings with different contour intervals.

The pupil is now ready to learn to read a government contour map. Put into his hands the map showing his own county. Let him locate on this places with which he is familiar, and learn to interpret the legend which he will find on the edge or back of the map. Now let him read the topographical part of the explanation given on the covers of the geological folio, at the same time putting into his hands the Shasta, Shasta Special, and Fargo North Dakota sheets, as being more simple types of topography than his home sheet is. There the contours are generally more regular and more easily followed. For questions on these maps, the teacher may follow any manual, such as Brigham's or Trafton's—but he will find many of the questions will seem too simple for the student, if this work has been provided by the work outlined above. The teacher should go over these questions carefully and be guided by the character of his class as to how many of them in the list may be omitted. After this work, present a number of different sheets to the class and let the pupils determine how many things they can discover in the quadrangle, even from a superficial inspection of the map. Give them a shorter and shorter period for inspection and see how many facts they can read at a glance. To further test the student's knowledge of what he sees, teach him to make cross-sections of different regions. A good explanation of these is given on Page 14 in Trafton, and in fact in almost any manual you pick up.

The next problem which confronts the teacher is the choice of maps to represent different physiographic types, and the order in which they should be presented. Davis begins with plains, as the first stage in the development of land forms—this being the most simple type which may rise from the sea—and passes on through plateaus, mountains and volcanoes, until he reaches the tearing down forces, and the changes they make in topography. Of course, the best example of these tearing down forces is rivers. Gilbert and Brigham, and several other texts, on the other hand, take up rivers first, as the chief agent of the modification of the topography, and having studied them, notice their action on different land forms. Fairbanks makes a compromise. He dips a little into the geographic cycle, its

causes and forms, and then develops the subject from plains up. Professors Marbut and Eliff, on the other hand, in their pamphlet entitled, "A Unit in Physical Geography," divide the subject something as follows: A simple plain, a plain with valleys, a plain with hills, a plain with hills and valleys. Then plateaus are divided the same way, and mountains are divided into simple mountains and mountains with valleys.

All of these plans are good, but the main thing is that the teacher must have in his own mind the order of development he wishes to present, and must make his selection of topographic maps to illustrate the facts which are best calculated to make this development clear to the mind of the child. Suppose he begins with plains. He must divide his plains into classes as the university circular does, or according to some other plan. Then he must select a quadrangle which best illustrates his reasons for having made these divisions. The selection of these quadrangles is not so difficult as it may at first appear because Davis in his *Teacher's Manual* and text mentions several illustrations for each type as he classifies them. Gilbert and Brigham divide the subject. Brigham, in his *Manual,* gives one illustration with the questions intended to call the pupil's attention to the principal fact about the sheet, and Professors Marbut and Eliff, in their circular, mention several illustrations of each class. These are especially good because, whenever practical, they have selected the quadrangle within our own state, a region with which every student should be more or less familiar. This is a good guide in selecting maps. They mean much more, both to teacher and class, where they represent some region with which they have some previous knowledge, however imperfect.

Having made a selection of a map, the question of presentation becomes a vital one. There are questions given in the different manuals which may be followed very exactly and in many cases the results are satisfactory, but it is best to adapt the work to the character of the different classes, and even to the individual. The interest is sure to be quickened in this way, and the whole result is better.

The main fact to be kept in mind is what is the end to be gained by means of the maps. It is simply a substitute for a personal observation of the facts, and as such it should be used. The ideal to be reached is that the pupil should feel that he has traveled over every foot of the ground with seeing eyes and understanding mind, and has grasped the topography in its entirety and detail. Before he is through, however, he must grasp the reason why the map is chosen as a type of topography which he is studying. The questions must bring out these facts. It is well to open the questions

with the subject of location of the quadrangle under discussion, because this helps to connect it with other facts known to the pupil, and also gives him an idea of how far outside of the quadrangle these same characteristics may be expected. This part of the work may serve as a review of Geography, because the state in which the quadrangle is situated may be studied, and the rivers traced from their sources to their mouths. Then should follow questions calculated to insure a thorough understanding of the legend of this map, including scale and contour interval. This subject of *scales* in the government maps is rather an interesting one, as they are given in ratios and must be calculated to be thoroughly understood. Unless the legend is thoroughly understood, a student may feel that a region is especially rough, when, if mapped with a larger contour interval, it may seem to have moderate relief.

Then must follow the questions leading up to the placing of the quadrangle in its class of topography. For example, if your quadrangle represents young topography, let the student note whether it contains lakes or falls in the river course, whether the country is well, or poorly drained; the character of the banks, flood, plain, delta and divide. Everything that marks a new region should be noted, and its absence or presence set down, in order that a conclusion may be drawn why this quadrangle was selected as an example of young topography. In this connection, it may be well to peep a little at the geology of the region, since this gives the student the only true conception of the causes of all the things he sees. His preparation for this should come before he begins the study of topographic maps. He should be made to feel that he only half knows the country until he has seen its *surface geology* at least, and the geological history if possible.

Lastly, the pupil's attention should be directed to any points of especial interest in the region, such as the principle products and manufactures, and the reasons for their location at this point; any points of scientific interest; the connection of this place with human life in the present and the past; how this type of topography has influenced the human race, and especially how it has effected the lives of those who dwell within the borders of this quadrangle. To bring all these facts out by a series of questions, will require only a little study on the part of the teacher. Care must be taken that the answer is not implied in the question. Even when a good manual is used, I would strongly advise going through it, omitting certain questions and adding others. A question may often seem foolish for one class, and very necessary for another. Then, often, the student may copy his answers from the corrected note-book of the student of the

previous year. Often, several questions may be well combined in one judiciously chosen.

As large a collection of maps as possible is advantageous because it is a good test of a student's understanding of a subject if he can select other maps having the same characteristics as the one he has just studied. This work also teaches him to read readily the maps presented, and to weigh the importance of certain characteristics in certain types. But such work is no substitute for the careful study of the character of one quadrangle under each type.

This brings me to the question of conducting class work in topographic maps. Many of the recitation periods may be turned into laboratory work to a great advantage, but, at least once a week, the class should be assembled for concerted study. The time may be used to go over the questions already answered during laboratory periods. Sometimes this may be done with the students' note-books open before them, in order that each may see the way the different facts impress his fellow students. Where such differences occur, if the teacher will allow, and encourage, some discussion of the reasons for the different views, it helps to add to the interest, and impresses the facts on the student's mind. Often it is well to review the maps with the note-book closed. This gives a good opportunity to judge of the student's retention of the more important facts. At other times it is well to place in the student's hands the map and allow him to answer from it some general questions, such as will sum up the facts he is supposed to have learned in his more careful laboratory study of the quadrangle. These questions may be selected from another manual than the one in use, or they may be compiled by the teacher to cover such points as he thinks important. Such questions, if properly selected, enable the student to generalize his knowledge, to grasp the map as a whole rather than in detail and to express these facts in a few concise words. Often the hour may be spent with profit by passing to different members of the class maps with which they are not familiar, and telling them to classify them according to the subdivisions they typify, and give their reasons for placing the quadrangle in this class. If a limited time of observation is given, and an expression obtained from at least a half dozen pupils, and their answers compared and criticized, it will help to develop quick and accurate thought.

As to the method of conducting laboratory work, there is little to be said, if the teacher follows a manual, except to see that the student keeps a neat and accurate note-book. The student must be guided, of course, but not over-helped. Care must be taken that one student is not doing the

thinking for others. But the specific plans will readily suggest themselves to every teacher.

The question of examination is not so easily settled, though the method of conducting a review should not be very dissimilar to a class recitation. The students should be able to name a locality which is a type form of each division of the subject he is studying; for example, if he is being examined on mountains, he must be able to divide them according to some such principle as this: Block mountains, folded mountains, mountains of circumdenudation, etc., naming an example of each kind, and giving his reasons for the selection of each quadrangle. In this connection, it is well to note that it is not necessary to require a student to remember the scale and contour interval of any such facts, but that he should remember the reason why it seemed to him that the mountain was, say, a block mountain. Then it would be a good test to ask the student to mention or discuss all the features of especial interest he remembers in some quadrangle. This will give the teacher some idea of how perfect the student's mental picture of the quadrangle is. Give the student the map, in some cases, and new questions, and let him look them up for himself. This will give the teacher a good idea of how much of his work is individual, and how much he depends on the aid of the teacher, or the aid of his fellow students.

We are now ready for the most important step in the paper. What result do we expect to gain from this work on topographic maps? The answer has been mentioned under another division of the paper, but I know of no way of making my point more emphatic than to *restate* what has already been said. The ideal we are striving for in the study of each quadrangle is to make the student feel that he *knows* that region, knows it as though he had examined it in detail with eyes which were trained to see *all* of its characteristics, yes, even more than this, for the student by means of the maps can study both detail and entirety. He is not content with tracing a stream or cliff for a few miles, but he can trace it from beginning to end, can see all that is essential, and omit all that is irrelevant. Unless the student has grasped some such conception as this when he finishes a subject, our work is useless.

The mental discipline of such physiographic work is the training of the memory and imagination, and the reasoning faculties. It is hardly necessary to touch on the training of the memory and reasoning faculties, after what has been suggested as to methods of conducting class and examination work. The student's imagination must be trained until he can, with the aid of the contours, make the hills and mountains stand up on his

paper; he must people the towns, and even take a glimpse at their methods of gaining a livelihood; he must cover the pastures with trees and grass.

Any one can see even by the very disjointed outline that I have given of this work, that it furnishes either a systematic substitute or preparation for travel, the culture value of which has been acknowledged through all the ages. A walk along a country road has taken on new meaning. The student sees all around him a type of some land form, and he can imagine from what it came, and to what it is tending. Every one knows that there can be no better preparation for seeing anything in its true light than a good, previously formed, mental picture of the object.

A student who has finished a course in topographic maps is able to locate people and events of which he reads. He is capable of giving them their true surroundings, and in this way is better prepared to judge of their cause and effect. If he travel through a certain region, if he read of a certain locality, should this region be one that he has studied, he feels acquainted with the country, and if it is a country with which he is unfamiliar he takes pleasure in classifying and placing the facts he has learned of it in its proper pigeon hole. Often a student of Physiography can tell you more of your own country than you ever dreamed was true.

Then let us keep up the work with topographic maps. Let us give it a prominent place in our courses in Physical Geography or Physiography. Let us give to Physical Geography a more prominent place in our school course. It is a science which comes very near to every child's life, which enables him to see something outside himself. It is a science for which equipment may be procured with less expense than many others. We have seen that it gives good training along many lines. Then let us make it our aim to have our pupils feel that this is a "world with surpassing beauty crowned."

[NOTE. The monograph by Salisbury and Atwood, noted in the JOURNAL for March, will help many teachers to follow the suggestive plan outlined in this article. EDITOR.]

THE USE OF LANTERN VIEWS WITH SCIENCE LECTURES

By William Herbert Hobbs
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TO general lectures on natural science the projecting lantern is proving a most valuable aid. For histology, and perhaps also for petrography and paleontology, where a minute study of form and texture is demanded, the modern reflectoscope may be found an even greater help; but for branches of science which deal with large masses, as do dynamical geology and physiography, the normal projecting lantern is the better adapted and the more economical. Some teachers who have at their disposal a reflectoscope are accustomed to introduce books into the apparatus so as to throw cuts directly upon the screen, but considerations of convenience, of manipulation, and of arrangement of material between lectures, no less than economy, are in favor of the lantern. The time has come when for large classes, at least, it is economy to prepare slides in considerable abundance from book cuts, and even from crude drawings or diagrams, instead of causing delay and diverting the train of thought through a transfer from screen to blackboard.

Some teachers there are who do not favor the use of the lantern on the ground that illustrated lecture courses are apt to go lightly over the surface of the subject treated, thus leaving the more difficult and the visually less impressive matters untouched. It may be that there is some ground for this objection, particularly when the lecturer is inexperienced and when sufficient thought has not been devoted to the acquisition and the selection of the views. It should further be taken for granted that students acquire a satisfactory knowledge of their subject only after individual study between class hours; and to insure this, as well as to clear up all difficult subjects, the lectures must be supplemented by searching quizzes, by excursions, and by suitably adapted laboratory work. This being granted, it is, we believe, true that a teacher who for any other reason than lack of necessary funds fails to provide lantern projection of some sort in illustration of his general lectures in geology or physiography, is neglecting a most important opportunity of reaching the student's mind through the eye—an opportunity which the present generation has been the first to realize. This appreciation has been synchronous with the introduction of cheap photography and cheap engraving, to which in a measure the appreciation is due.

The cost of providing lantern facilities is probably much less than many suppose, for an excellent lantern with suitable connections and necessary

curtains can be obtained for from $75 to $100. In addition to this cost of installation, there will be the expense of current and slides, the latter a gradual acquisition like the furnishings of a home.

In universities it has sometimes been the custom to turn over to subordinate members of the staff, the lectures which have an elementary character. It is the belief of the writer that the proper conduct of such courses is the most difficult, and that experience in teaching is here above all things essential. The young Doctor of Philosophy who has been listening to lectures on the more intricate problems of the science and engaging in research along essentially special lines, is for these reasons hardly qualified to conduct a course where the most important of all aims should be to arouse an interest, and where little that is not demonstrable should be presented. Through frequent repetition and by supplying each link to the chain of evidence, the great fundamental truths of geology may be each in turn unfolded; and for this no one should be so well qualified as the head of the department.

There is ground for a belief that the methods in general use for arranging and for drawing upon a lantern slide collection as required for lectures, may have been responsible for some lack of interest in their use. If, before meeting his class, the lecturer must not only go over the outlines of his topic, but has in addition to hunt up from a more or less scattered collection the slides to illustrate it, the added burden may prove a discouragement.

The method of slide arrangement which appears to be in most general use where large collections are available, is to arrange the slides in drawers after the manner of cards composing a library catalogue, or perhaps to use consecutive accession numbers for the slides and refer to each by means of a card catalogue. Special slide drawers adopted for this purpose are now regularly manufactured. With such a method, the lecturer may hand to his assistant the numbers of slides in their order as they are needed for each lecture, and the slides may be assembled for the lecture and later returned to the drawers without his personal supervision. Considerable time on the part of some one is, however, required, and the system, being elaborate, is subject to serious derangement unless the one operating it is methodical and orderly in his habits.

Some teachers have advocated the use of a series of wing cases such as are employed in public libraries for the display of pictures and engravings, the slides being very readily seen in pockets against the white background; but despite the apparent advantage of easy inspection, this method is probably less satisfactory than the other. No doubt there are other

methods which have been devised by different teachers, each method having its special advantages, and it would be desirable that some description of these should be made in print.

The method used by the writer differs from any which he has seen in use, in that it makes the course of lectures the primary basis in the classification of the slides. If a number of lecture courses are given by the department with the aid of lantern slides, there must, of course, be several collections, or, rather, sections of the collection. It has been found most convenient to store these several collections in the offices of the instructors to whom the treatment of the subjects covered by each series has been

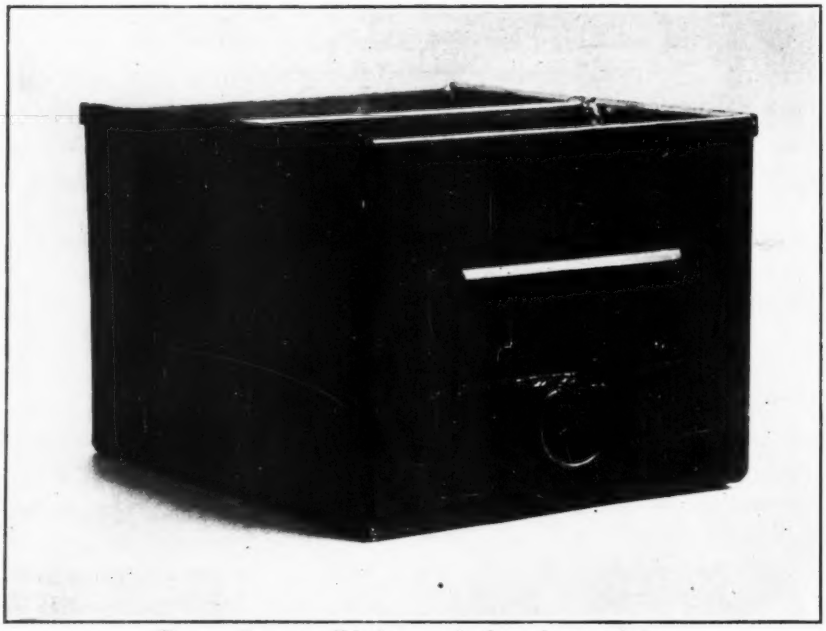

FIG. 1. Lantern slide box made from japanned tin

delegated. This does not altogether prevent the common use of certain important groups of slides, the subject of which may be merely touched upon in one course and gone into thoroughly in another; but it is in most cases better, if at all possible, to make extra positives from the negatives which are on file in the department.

The units in the system used for storing the slides are boxes made of japanned tin 3½ inches by 4 inches on the bottom and 3 inches in depth, these boxes being divided into front and rear halves by a partition of tin. (See Fig. 1.) Each half of the box accommodates 16 slides which stand

on the shorter edge and allow the label to be read at the top. It is intended to fill but one compartment of the box, the other being provided for depositing the slides as they are taken from the lantern. On both the front and the back of the boxes are exactly similar label holders, and further, small rings which are to be used when necessary in removing the boxes from the shelf. The slide boxes are, therefore, reversible, and each is devoted to one or more subdivisions of a general topic, both the broader division of the science under which this falls and the special subdivision being indicated in the label.

The case in which the boxes are stored is one which was formerly used for the display of rock specimens, but this has been found admirably suited to the purpose. The case contains shelves four inches in width separated by 4½-inch spaces and in length limited only by the size of two hinged glass doors which close the case in front. The altitude of the case is fixed by the height of a shelf to which one may conveniently reach. (See Fig. 2.)

Such a case as is described may be placed against the wall of a room, and takes up but little space in it. Within the case the filled slide boxes are arranged under their proper subjects and numbered consecutively, so that when taken from the shelves they may be easily returned to their proper places. The arrangement of topics is that adopted for the course of lectures, and all slides are excluded except such as are generally used.

When preparing his lecture the teacher opens the case, where he finds all topics arranged in order before him, and can withdraw the slides corresponding to each without the necessity of opening and closing drawers. Beginning with the first box needed for his lecture, he arranges the slides, if they are not already in order, placing any not desired in the rear compartment of the box. This box is now placed in the left front corner of a wooden tray capable of holding eight boxes; and the other needed boxes, as soon as they have been arranged, are added to the tray in their proper order. Almost unconsciously the thumb marks are seen to be in their proper positions. This loaded slide tray is now ready for the assistant who operates the lantern, and each slide when it has been projected is dropped in order into the rear compartment of the box from which it was taken.

After the lecture the loaded tray is put away until such time as the preparation of the next succeeding lecture must be undertaken. The earlier boxes of the series are then returned to their places upon the shelf, and of the later ones a selection of slides is made and these are placed in the front compartments. These again go to the lantern and serve to give

emphasis to the review with which the lecture opens, at the same time that they establish the continuity of the course. New slide material is added in the same manner as before.

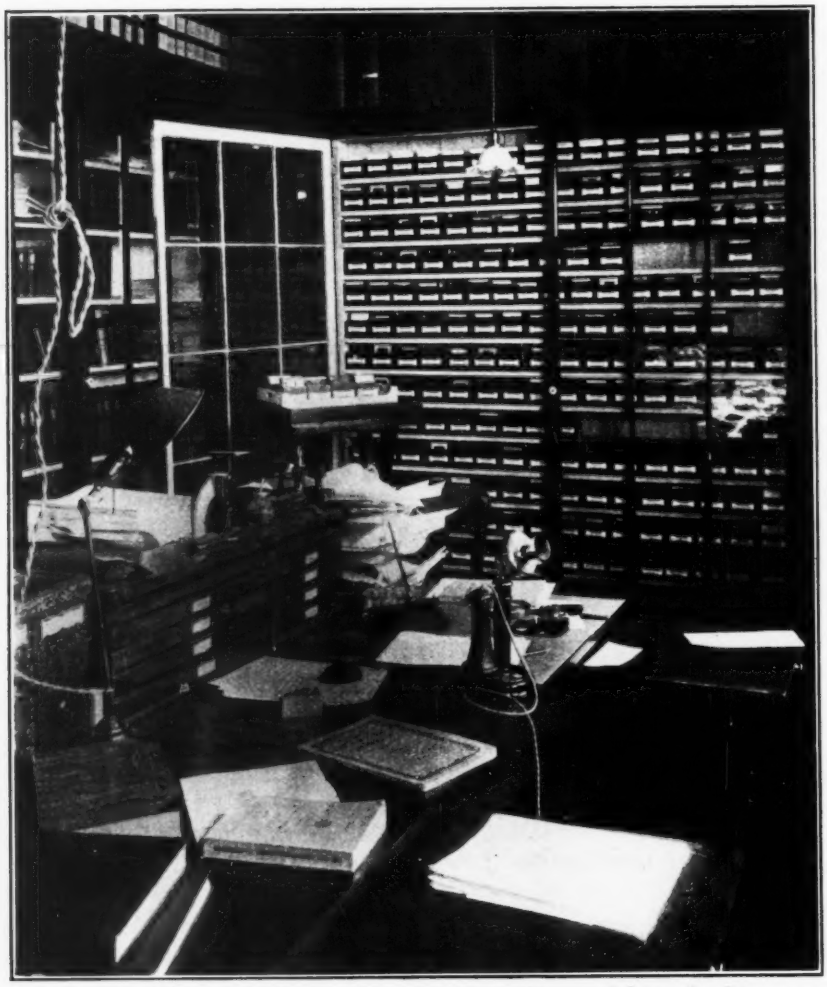

FIG. 2. Case filled with lantern slides in boxes. The special stand with a tray of slide boxes is in front

It is found convenient to have a specially constructed stand for use both while arranging the boxes of slides for the lecture, and for the lantern operator to use during the projection. These stands are exact duplicates and are made in two separable parts, a tray-like top and its support. The

support is a strongly-made folding stand, 40 inches high, constructed like a camp stool and having its width when open fixed by small steel chains at the top. The top is a wooden tray 16″ x 20″ and an inch in depth. It

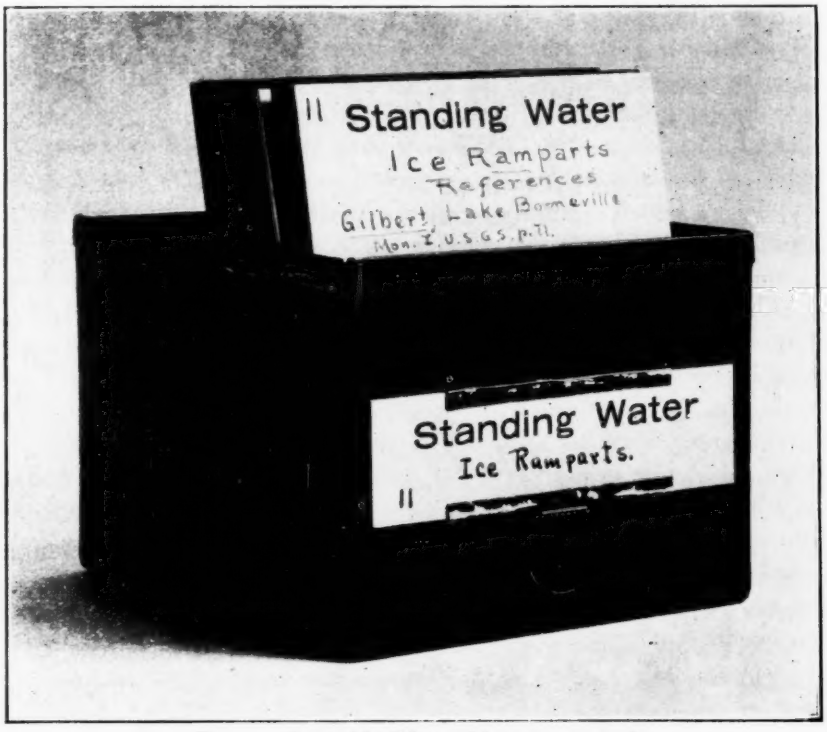

FIG. 3. Case with slides and lecture note cards

is kept in position by four stout wooden dowels which fit loosely into holes in the top of the support. This stand appears in Figure 2.

If desired, the slides may be arranged directly in this tray, which when ready is carried to the lecture room and put in place on the exactly similar stand. Between lectures this stand is folded up and put out of the way. Where there is ample room and where several lecture courses are running at the same time, it is more convenient to use wooden trays somewhat smaller in size, which fit into the stand tray and may be more easily carried from room to room, and also may be put away upon shelves that are free from dust.

With the duplication of positives for the several sections of the collection, the collection of slide negatives acquires new importance. Each

negative is contained in a paper cover of the usual form and bears simply an accession number, the corresponding number being borne on the slide label of all positives prepared from it, no matter in which section of the slide collection they may be kept.

The system here described is easily modified to fit both the growth of the collection and the advance of the science. Whenever a new paper of importance appears, if it contains an adaptable illustration, the paper is set aside for the preparation of a slide, and this, when ready, either takes the place of a less suitable one, which is thereby relegated to an overflow collection, or it is inserted in its proper place among the others.

Supplied with a relatively complete collection of lantern slides, lecture notes become less important, since the slides themselves are the speaker's mentors. From time to time he will, however, need to present figures or to give references to volume and page for outside reading. In place of manuscript lecture notes, cards of bristol board of the same size and shape as the slides are inserted in the slide boxes. These cards bear printed at the top the name of the topic (as, for example, Glaciers) as well as the number of the box of slides, to which each pertains. (See Fig. 3.) When the lecture is being prepared through the assembling of the slides, the teacher removes the cards in their order as his lecture notes, and returns them to the boxes when the lecture is over. It is a simple matter to add to these notes, whenever conference with colleagues or reading suggest addition or change, and lectures are thus less likely to run in grooves and become antiquated.

NOTES

ON THE SHORTENING OF DISTANCES BY THE PANAMA CANAL.—The sole object of a ship canal is to shorten sea distance. The following figures are actual steaming distances as calculated by the United States Hydrographic Bureau. From New York to Panama, or to any port on the Pacific Coast of America north thereof, a reduction of 8,400 miles. From New York to ports on the American-Pacific Coast south of Panama a reduction varying from 8,400 miles to about 1,000 miles, on an average about 5,000 miles. The corresponding reduction from Liverpool to these coasts is 6,000 and about 2,600 respectively. The figures for Antwerp are about the same. From New York to Yokomaha, *via* San Francisco, the reduction is 3,729 miles, bringing the Japanese port 1,805 miles nearer to New York than to Liverpool. From New York to Shanghai the reduction is 1,629 miles, which leaves Liverpool 295 miles nearer to Shanghai.

The Panama Canal will not shorten the distance between New York and Hong Kong, Suez being still the shorter route, and even to Manila the reduction *via* Panama is only 16 miles; moreover, this small reduction is by way of San Francisco and Yokohama. The all-American route from New York to Manila *via* Panama, Honolulu, and Guam is 128 miles longer than that *via* Suez. As we go farther south in the Pacific, however, the Panama route is again the shorter from New York. Thus the distance to Syndey is shortened by 3,806 miles (*via* Tahiti), the distance being 2382 less than that between Liverpool and Sydney *via* Colombo, Adelaide, and Melbourne. The reduction between New York and Wellington, N. Z., will be 2,542 miles, bringing Wellington 2,759 miles nearer to New York than to Liverpool.

The distance between Liverpool and Wellington *via* the canal is slightly less than that by the Straits of Magellan. There is also a reduction of distance between Liverpool and the northern parts of the Siberian coast. Otherwise the Panama Canal does not shorten distances between European ports and those on the "Oriental" side of the Pacific, the route having been short-circuited by the construction of the Suez Canal.

New Orleans and other ports on the Mexican Gulf obtain even greater reduction of sea distance to Pacific ports than that obtained by New York; and the important island of Jamaica, with its spacious harbor of Kingston, will be placed in a position of centrality for world commerce which it does not at present enjoy. That the canal will greatly increase the importance of Jamaica as a member of the British Empire there can be no doubt.

We have seen that the greatest reductions of distance resulting from the canal are those between the two coasts of North America. The sea route, however, remains much longer than that by railway, so that the commercial benefit is (relatively to reduction of distance) less than in the opening up of the Pacific Coasts of South America, New Zealand, Japan, and the northern parts of Asia. The approximation of the two coasts will, however, have a profound effect upon the naval position of the United States.

Finally, we must note the peculiar position of that part of the world lying between 40° N. and 40° S., and the meridians of 120° E. and of 160° E. of Greenwich. This band, which includes Japan, Korea, Shanghai, the Philippines, New Guinea, and most of Australia, is peculiarly situated with respect to canal routes to the manufacturing countries of the Occident.

Near its western margin the Suez and Panama routes to New York are of equal length. Near its eastern margin, which lies, however, mostly at sea, the Suez and Panama routes to Liverpool are of equal length.

On a line rather west of the center all places are equidistant from New York and Liverpool, the former *via* Panama, the latter *via* Suez.

—From *The Geographical Journal*, February, 1909.

CHICAGO'S COMMERCIAL OPPORTUNITY.—One of the remarkable phenomena of the nineteenth century was the magical rise of Chicago. From a struggling village sunk in the mud of a prairie creek it rose within the memory of living men to a great metropolis, ranking fifth in the roll of the world's great cities.

It was inevitable that Chicago should assume this rank, for Chicago is a city of destiny. The record of the past lies open, and he who will may run the gamut of the causes which have worked together in the production of the present metropolis. And if this be wisely done, we shall be in a position to evaluate the resources and forces geographic and economic which condition our future growth. And so we can plan sanely for a long future and for a greater city than has yet been.

Chicago has developed in an era of dominant east-west traffic. For the traffic of America up to date has been most largely a sending of raw materials to the old and densely populated lands of Western Europe, and receiving back the manufactured articles which such peoples produce. Few people realize what a large fraction of the world's commerce it is, which goes on across the North Atlantic. The only other flow of trade comparable is that from the same European ports to the Orient and to the Tropics. The trade of the Pacific-Indian ocean, and our trade with the Tropics are

insignificant compared with this traffic of the North Atlantic. This great flow of trade from West Europe to the Tropics should be remembered with reference to Chicago's future. We, too, have a potential highway leading to the Tropics, which we shall some day use.

The next element of advantage in the growth of Chicago is the fact of our location in the heart of the great American lowland, which, smooth and fertile, covers the eastern half of our country. The significance of this is patent when we recall that over 90 per cent. of the world's food supply and population are found on the land below an elevation of 2,000 feet. This great eastern lowland of ours, in addition to a matchless climate, inviting the production of the great cereal and other crops, and the growth of forests, has the smooth surface which invites the building of roads and railways, and the use of labor-saving farming machinery. And this eastern lowland compares favorably with all Europe in the productive power of its mines and soils. Chicago's superlative advantage lies in her position in the heart of this splendidly productive area. And in this area a peculiar influence compels the growth of a great commercial focus at Chicago, and that is the size and position of Lake Michigan, which spreads its awkward 300 miles of deep water right athwart the lines of east-west traffic, so compelling land lines of transportation to concentrate round the southern end of the lake. The flat land, the fertile soil, the markets at the east and the Great Lakes compel a metropolis at the place of Chicago. That is why the 27 railway systems focus at Chicago, making the greatest railway center on earth. For railways are built where it pays to build them, where there is freight to be carried. Let us take an account of stock of the resources of the hinterland of Chicago, so we may be sure why we are great, and how much growth is yet to come from the resources assured.

The region round Chicago, which looks to Chicago as the market of its chief commodities, and to the Chicago merchants for a goodly share of their purchases, is what is considered our hinterland. Roughly, this is an area which, while only extending eastward into Michigan and Ohio, reaches on the south, west and northwest from 750 to 1,000 miles and over. This is an area rich in mineral resources, and the richest area of the size on earth in the matter of soils. It is this area which produces the most of the limestone and cement rock, which in 1906 were valued at $55,000,000. The American output of coal, which in 1907 was 370,000,000 tons and valued at $513,079,809, was about one fourth of it produced in the Chicago area, and the great Pittsburg field, which produces nearly one half of the Amer-

ican coal, is not so far away but it furnishes us a deal of coal and coke, both by lake and rail.

Then there are the metals. Very rich deposits of iron, copper, lead and zinc contribute to the wealth of the Chicago region. Of these, the iron output of the country was alone in 1907 worth $529,958,000, about 80 per cent. of which was taken from the mines in the Lake Superior region. This iron is mostly worked up in the Pittsburg region, because the coke, the limestone and the markets are there, and the Great Lakes provide the cheapest of all transportation.

But better than all the minerals and ores is the *flat land,* the *fertile soil* and the *good climate* of the Chicago area. A mine yields but one crop, and the resource is gone forever. But these rich soils will keep on producing their great crops for to-morrow's ten thousand years. And it is the crops from these rich farms, more than all the minerals, which have made America great and Chicago a metropolis. The soils in the Chicago region are the richest on the continent. This is because they are new soils, contributed by the melting ice sheet of the Great Ice Age; soils gathered from the thousand miles of Canada passed over in the southward flow of the great ice. Such soils have all the constituents needed by vegetation. The area of this rich soil, once known, can be discerned in maps showing the distribution of corn, wheat, oats, hogs, cattle, improved land, cities and railways. And we have only begun to develop the possibilities of this new soil. Let us look at a few of these rich crops, remembering that it is the toll on these commodities which has made Chicago grow great and New York far greater. They are the bank account upon which the Chicago of the future must draw in its growth.

The wheat crop of the country in 1907 was 625,576,000 bushels, valued at the farm at $500,000,000. The center of wheat production is in western Iowa, about 400 miles west of Chicago. The surplus crop moves eastward to its market and through her whole history Chicago has levied tribute on the crop in transit. It has been one of the greatest sources of bone and sinew in our growing commercial frame.

The maize crop of America in 1907 was 2,553,732,000 bushels, valued in the farmer's crib at $1,350,000,000—a sum equal to three fourths the value of the entire mineral output of the whole country in the same year. And this is the crude corn before it is converted into pork and butter and starch and glucose and the long list of other high-priced commodities which finally get to the consumer. Three fourths of this gigantic crop is grown

in the area commercially tributary to Chicago, and this city is its natural market.

One third of this corn crop is fed to the hogs, and a swine map is quite the counterpart of the corn map. One could be substituted for the other. The year's swine are worth $325,000,000 and most of them go to market by way of Chicago. Hogs and cattle have been far and away the largest contributors to the wealth and upbuilding of Chicago, and it is as the source of meat foods that Chicago is known the world around.

The oats crop is a sort of understudy to the corn. In 1907 this crop was 741,521,000 bushels, valued at $360,000,000. And again the lion's share of the nation's yield is in the Chicago area.

Hay, too, which has risen to second place in crop values, shows the same great concentration in the central lowland, and following corn and hay, the distribution of cattle discloses the old story of maximum wealth in the Chicago region. Not on the Great Plains, but here on the rich corn lands looking to Chicago as the chief market, the bulk of the nation's cattle are kept. In every port of Western Europe the business men I met knew Chicago as the source of most of their imports.

Only a few of the great resources have been mentioned, but each one exhibits the one significant fact, that Chicago is a great commercial focus, because conveniently located to handle the products of the rich central lowlands, and to send back to the producers on the farms the multitude of commodities a prosperous and intelligent people demand. And Chicago is great in proportion as she is an efficient clearing house for this gigantic hinterland. For the hinterland of Chicago is one which in natural wealth and possibilities rivals not one European country alone, but all of Western Europe combined.—From *The Development of Commercial Ports.* Report to the Chicago Harbor Commission. By J. Paul Goode.

Capital of the Commonwealth of Australia.—The House of Representatives of the Commonwealth of Australia has voted to place the future capital in the district Yass-Canberra, in southeastern New South Wales. As the conflicting interests of New South Wales and Victoria have defeated earlier decisions as to the site of the capital, it is expected that the present proposal also will meet with opposition.

The federal capital, according to the Constitution, is to be in New South Wales not less than 100 miles from Sydney. Its territory is to contain at least 100 square miles, and the Crown lands in the area selected for the capital are to be given by New South Wales without payment. The

capital *pro tem* is in Melbourne, and will remain there until its situation is finally decided upon and the building is ready for occupancy.

A commission to report upon the most suitable site was appointed in 1901. The commissioners recommended Tumut, which has a fine situation and climate, excellent water supply and adequate rail communications. It is also removed from the coast, and, therefore, safe from naval attack. The House of Representatives in October, 1903, recommended Tumut, but the Senate substituted Bombala, probably because the proximity of this situation to the coast would enable it to have independent access to the sea through Twofold Bay. When the matter again came up in 1904, both Houses selected Dalgety, on the Snowy River, near Bombala. Objections, however, were made to this proposal and nothing further has been done until the House lately announced Yass-Canberra as its choice.

NEWS ITEMS

Professor W. M. Davis, President of the Association of American Geographers for 1909, has appointed the following members of the Association a special committee on Secondary School Geography to report at the next annual meeting: Professor A. P. Brigham, Colgate University; Professor R. S. Tarr, Cornell University; Professor R. H. Whitbeck, Trenton State Model School; Professor C. F. Marbut, University of Missouri; and Professor Richard E. Dodge, Teachers College, Columbia University (Chairman). This committee was appointed as a result of the Round Table discussion noted in the February number.

The twelve-inch Meteorological Globes prepared by Professor C. Kassner and published by D. Riemer of Berlin should be in every high and normal school laboratory in which climate is studied. They present the seasonal pressures and temperatures for January and July in a more graphic and studiable way than any maps available.

Professor R. S. Holway of the University of California announces a camping summer school in the Santa Cruz mountains from June 21 to July 31, 1909.